Paper Number: 4135

Sustainable Options to Manage Acid Mine Drainage in the Witwatersrand Gold Fields

Coetzee, H.[1,2]

[1]Council for Geoscience, 280 Pretoria Street, Silverton, Pretoria, South Africa, *henkc@geoscience.org.za*
[2]Department of Geosciences/Africa Earth Observatory Network, Nelson Mandela Metropolitan University, Summerstrand Campus, Port Elizabeth, South Africa

---

Gold and, in some cases, uranium have been extracted from the sulphide-containing conglomerates of the Witwatersrand Supergroup since the late 1880s. The earliest discoveries were made in the Central Rand, West Rand and East Rand Gold Fields, in and around what was to become the City of Johannesburg. Mining commenced on the surface outcrops and rapidly progressed to underground operations, extending to great depths. In the case of each of the three original gold fields, the underground workings were connected, resulting in three large interconnected underground voids developing. Underground connections were not developed between the different gold fields where structural and other geological features interrupt the continuity of the ore bodies.

During the heydays of mining, the individual mines dewatered their own workings. As mines closed, they began to flood and, where interconnections existed between adjacent mines, water began to discharge into the adjacent mines, increasing the amount of water they needed to pump. Eventually, a situation developed where all the water entering the underground workings of each gold field was pumped from a single mine, until that mine ceased operations. In the three old Witwatersrand Gold Fields, pumping ceased completely in the West Rand in the late 1990s, the Central Rand in 2010 and the East Rand in 2011. Following the cessation of pumping from the West Rand mine workings, these workings began to flood, discharging first to an adjacent aquifer.

In 2010, an Inter-Ministerial Committee was formed to deal with acid mine drainage in the Witwatersrand, with an expert report adopted in 2011 [1]. The compilation of this report was complicated by a lack of reliable historical data on inflow volumes and water chemistry, forcing the adoption of a conservative approach, based on a combination of pumping and treating to maintain the water level in the voids at safe levels, termed “Environmental Critical Levels” and various measures to reduce the ingress of water to the underground workings. To date, the construction of plant and infrastructure for pumping and treating has progressed, although costs have proven extremely high. A long-term, even more costly, programme based on desalination of mine water has been developed but has not yet been approved.

A number of options need to further exploration as they could offer more sustainable options. These include:

- reducing the volume of water entering the underground voids via the canalisation of streams where they cross zones of shallow undermining and the closure of points of known water ingress;
- raising the environmental critical levels to reduce pumping costs and, if possible, the construction of gravity-driven discharge points;

- Lower cost treatment of mine water or the implementation of measures to improve the quality of water pumped; and
- Reduction of seepage from mine residues located above zones of shallow undermining.

Owing to the uncertainty which have characterised most studies searching for solutions to the problems related to mine flooding in these areas, more comprehensive monitoring and research is required to provide more reliable inputs into future solution development.

References:
[1] T. Ramontja, et al. (2011) *Mine Water Management in the Witwatersrand Gold Fields With Special Emphasis on Acid Mine Drainage* Inter-Ministerial-Committee on Acid Mine Drainage